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## The AH-64D Apache Longbow, Affordable Evolution

Hugh M. Dimmery  
The Boeing Company  
5000 E. McDowell Road  
Mesa, Arizona (USA) 85215  
PH: 480/891-8434  
FX: 480/891-4559  
[Hugh.M.Dimmery@Boeing.com](mailto:Hugh.M.Dimmery@Boeing.com)

The U.S. Army and Boeing Rotorcraft are enhancing the capabilities that made the AH-64A Apache the best attack helicopter in the world. These enhancements are resulting in the most capable, fully integrated, combat weapons platform for the twenty-first century: the AH-64D Apache Longbow.

The Apache was the result of the requirement for an advanced attack helicopter. In the early 1970s, the U.S. Army decided to replace its AH-1 Cobra fleet based on lessons learned from its history (Vietnam), and an analysis of its primary threat, the former Warsaw Pact. The Army's concept was to use "massed forces for massed effects."

New technologies enabling standoff weapons employment; the ability to perform multiple target engagements; and night operations capabilities were combined with redundant systems; ballistically tolerant components; and a crashworthy airframe and cockpit resulting in the AH-64A.

The AH-64A entered service in 1986 with the U.S. Army and later with five international defense forces (Israel, Egypt, Saudi Arabia, the United Arab Emirates, and Greece).

In the Army's endeavor to field a twenty-first century platform, the AH-64A Apache provides the basic airframe; and all the basic survivability features that make it a great, survivable aircraft are retained.

Boeing is digitizing the combat proven AH-64A Apache. Using "state-of-the-art" technology, the AH-64D now merges sensor inputs; generates mission data; generates graphical displays (a picture is worth a thousand words); and manages a wealth of information resulting in a totally integrated weapons platform.

At a glance, the crew has a graphical picture of the battlefield. In the AH-64D, the weapon processors are cooperative and redundant. They share information continuously so that if one fails, the other automatically picks up the load. The Enhanced Global Positioning System Integration (EGI) is also cooperative and redundant and the Inertial Navigation Unit (INU)

functions as the primary navigation unit. It is updated two times a second by Global Positioning System (GPS) satellites and receiving Doppler rate sensor input to provide better weapons firing solutions. If the satellites are shut down, it still navigates. The AH-64D experiences three-meter (3m) accuracy virtually every place it operates. That is not as important for navigation of the aircraft, as it is for the collection and digital dissemination of tactical information with other AH-64Ds and compatible aircraft (AWACS, JSTARS) or ground station(s).

The AH-64D is equipped with four (4) on-board radios: two (2) Single Channel Ground-Air Radio System (SINCGARS); one (1) Ultra High Frequency (UHF) Have Quick II; and one (1) Very High Frequency (VHF) Amplitude Modulating – Frequency Modulating (AM - FM). All are capable of secure voice transmissions. The SINCGARS and Have Quick radios possess a frequency hopping (anti-jam) capability. The aircrew can communicate by voice or digitally, in the clear; ciphered; or frequency hopping on any radio.

A Fire Control Radar (FCR) is mounted above the rotor. It is a low power, narrow beam, and frequency agile, low probability of intercept millimeter wave radar. It automatically detects, classifies, and prioritizes targets in five (5) symbol sets: wheel vehicle; track vehicle; air defense; helicopter; and fixed wing. A small number of unknowns can also be placed on the screen. If it is a close-in target, it may also be targeted for destruction. Each of the symbols displayed to the crew is supported by a wealth of information: latitude; longitude; UTM grid; altitude of the target; target classification; and target track information. The crew can display 128 targets and have all of those 128 targets backed up with all of the data described. The FCR prioritizes these targets automatically for the crew. The aircraft has a number of prioritization schemes. The crew can also change those priorities anytime during the flight. The prioritization is very basic: either predator or prey. If it is predator, then it is destroyed first. If it is prey, it is destroyed after all predators. The system considers day, night, moving, stationary, range to the target, and target classification. Air defense is the most dangerous and emitting air defense is even more dangerous.

A Radar Frequency Interferometer (RFI) is an array of small passive antennas mounted underneath the FCR, above the rotor system. The array functions very effectively as a radar warning system, providing 360 degrees of coverage.

The Target Acquisition and Designation Sight (TADS) is the primary visual sensor used by the copilot gunner (CPG) in the front seat. It is also the backup night pilotage sensor. The TADS contains Forward Looking Infrared (FLIR) and Day Television (DTV) sensors; a Laser Range Finder (LRF); and Laser Spot Tracker (LST). The spot tracker has the ability to acquire laser energy from any other tri-service compatible designator.

The Pilot Night Vision Sensor (PNVS) is the primary night pilotage sensor for the pilot in the back seat. It is mounted above the TADS on the nose of the aircraft; and operates in the infrared (IR) spectrum.

The Integrated Helmet and Display Sighting System (IHADSS)  $\frac{3}{4}$ " television screen attached to the helmet in front of the pilot's right eye is the primary display for the PNVS and aiming reticle for weapons. The sensors and the weapon systems are linked through the integrated weapon processors, which ensures the sights are looking the same place the crew is looking. The radar can detect a target and very rapidly cue any of the weapon sub-systems: air-to-air missile; HELLFIRE missiles; 70 mm rockets; the 30mm chain gun, or in this case, the TADS. All sensor and weapon sub-systems can be linked.

The AH-64D crew stations are nearly identical, the exception being the Optical Relay Tube (ORT) in the CPG station. There is a Data Entry Keyboard (DEK) located on the left side of each crew station, designed so that it can be easily utilized with the left hand during any mode of flight. Data can also be automatically input using a data transfer cartridge, programmed in the operations center using a Mission Planning Station, and carried to the aircraft and inserted in a data transfer receptacle in the pilot's station.

The aircraft is designed to increase crew effectiveness. Fully digitized crew stations enable "management by exception," transferring work from the crew to the aircraft. The aircraft also gives the aircrew superb capability for battlefield coordination. The crew can precisely divide the battlefield to control team fires, similar to the way you would do so with a mouse on your computer. The crew can also identify friendly locations in the same manner it identified priority fire zone box locations. A "no fire zone" inhibits the weapon system from targeting anything within that box. Like every other system on the aircraft, the crew has the ability to re-enter the loop at any time. If a pilot sees an enemy in the no fire zone, he can, in fact, target and destroy him.

The weapons delivery capability of the AH-64D implies a well-armed force suited for any contingency on the modern battlefield, in reduced visibility, day or night.

The AH-64D air-to-ground, anti-armor missile system is the HELLFIRE. It is the primary weapon for the destruction of tanks and other hardened point targets. With four launchers installed, the AH-64D can accommodate up to 16 HELLFIRE missiles in any mix of types. A MIL-STD 1760 launcher has been developed for the AH-64D permitting operation of all HELLFIRE missile models from a single launcher. The HELLFIRE missile system is resistant to active and passive countermeasures. Crew station controls allow the aircrew to enable the counter-countermeasures and minimize the impact of battlefield obscuration.

The Aerial Rocket System complements other AH-64D weapons in providing the capability to fire rockets while on the ground or in the air, at speeds from hover to maximum level flight speed. The AH-64D accommodates up to four lightweight rocket launchers with a total payload of seventy-six (76) Hydra 70 FFARs. The Hydra 70 FFAR is a powered 70mm semi-ballistic projectile with no guidance other than its initial trajectory path. In addition, remote set fuzing capability is incorporated and accommodates use of both penetration and proximity fuze types. A Multi-Purpose Sub-Munition warhead permits use of a "wall in space" technique to achieve highly controlled dispersion and increased sub-munition effectiveness. The wall in space concept is achieved through the use of air burst fuzing and high drag sub-munitions which alleviates sensitivities to variations in pitch angle. A flechette warhead allows effective engagement of exposed personnel and unarmored vehicles and, to a limited extent, airborne targets.

The M230 30mm automatic gun is a single barrel, externally powered, chain driven weapon system firing electrically primed ammunition at a rate of 625 RPM. The gun is mounted in a flexible turret located on the forward underside of the fuselage. Its hydraulically driven turret is capable of slewing  $11^{\circ}$  up,  $60^{\circ}$  down, and  $110^{\circ}$  left or right of the armament datum line. The gun's ammunition handling system stores approximately 1,200 rounds of 30mm linkless ammunition and delivers it to the gun on demand. It is used to neutralize or destroy light armor vehicles and other light material targets. It provides an inherent self-defense capability against unanticipated encounters with either ground or airborne targets.

The Air-To-Air-Missile system is designed to ensure an effective self-defense air-to-air missile capability is always available without impacting the ordnance load on the primary weapons platforms. The system accommodates up to four ATAMs carried in pairs and installed on

the ATAM airborne launchers at each wing tip station. The ATAM system can be employed by either crewmember independently or in a cooperative, precision mode. The AH-64D accommodates all Stinger ATAM variants in current or planned use.

The U.S. Army plans to employ the AH-64D in its inventory until approximately 2025. With this goal in mind, Boeing and the U.S. Army are working on a cooperative program that will improve AH-64D durability range and endurance while reducing system operating and support (O&S) costs.

Drive Train 2000 (DT2K) will incorporate five (5) major enhancements to the current AH-64D: an advanced main rotor system; a re-engineered center fuselage; a new transmission; a new drive system; and new engines.

Through the use of five composite blades and advanced aerodynamic design that includes the use of elastomeric bearings for blade motion and retention, the advanced main rotor system will achieve lower vibration levels and improve performance.

An integrated design and manufacturing approach using enhanced modeling and simulation tools will shorten design and build cycle times, reduce structural weight, and improve the structural integrity of the AH-64D.

A new transmission and compatible nose gearboxes, clutches, shafting, and lubrication will increase horsepower capability. This increased horsepower capability will enable incorporation of new 3000hp engines currently under development.

In summary, the AH-64D is designed for growth; and is being improved based upon cost affordable evolution. With over, one (1) million hours of service, it is the world's only 4<sup>th</sup> Generation attack helicopter, proven in combat, and proven in peacekeeping. It's lethal information dominance will keep the world's premier attack helicopter viable well into the third decade of the 21<sup>st</sup> Century.